CLAIMS

Having thus described the aforementioned invention, we claim:

1. An apparatus for monitoring a production process performed by a production machine, said apparatus comprising:

a plurality of sensor modules, each of said plurality of sensor module accepting an input from a sensor selected from the group consisting of a linear variable differential transformer, a current loop, a dc voltage sensor, a differential voltage sensor, a piezoelectric vibration sensor, and a power sensor, each of said plurality of sensor modules including a signal conditioning circuit for conditioning said input;

a plurality of module slots each adapted to receive one of said plurality of sensor modules;

a processing device performing a method of monitoring a production process, said method comprising the steps of:

(a) identifying the sensor module installed in each of said plurality of module slots;

(b) calibrating the sensor module installed in each of said plurality of module slots;

(c) acquiring a stream of data from the sensor module installed in selected ones of said plurality of module slots;

(d) processing the stream of data;

(e) generating a visual presentation for the stream of data;

an interface circuit in communication between said plurality of module slots and said processing device, said interface device converting analog signals into digital signals and digital signals into analog signals;

a display device in communication with said processing device, said display device displaying said visual presentation in a human readable format;

a gain control circuit in communication responsive to said processing device and in communication with said signal conditioning circuit in each of said plurality of sensor modules, said gain control circuit amplifying the stream of data from the sensor module installed in selected ones of said plurality of module slots;

an offset control circuit in communication responsive to said processing device and in communication with said signal conditioning circuit in each of said plurality of sensor modules, said offset control circuit applying a dc voltage offset to the stream of data from the sensor module installed in selected ones of said plurality of module slots;

a latch control circuit in communication responsive to said processing device and in communication with said signal conditioning circuit in each of said plurality of sensor modules, said latch control circuit holding values of the stream of data from the sensor module installed in selected ones of said plurality of module slots;

an input device in communication with said processing device, said input device accepting commands from a user thereby allowing the user to control said processing device; and

a storage device in communication with said processing device, said storage device for storing said data for later recall.

2. The apparatus of Claim 1 further comprising a machine interface in communication with the processing device and a control circuit of the production machine having control over various process parameters, wherein said processing device accepts commands from said input device and generates control signals transmitted through said machine interface thereby allowing a user to adjust the various process parameters of the production machine.

3. The apparatus of Claim 1 further comprising a switching circuit in communication with said plurality of modules slots, said switching circuit adapted to split the input from one of said plurality of sensor modules into a first signal and a second signal, said switching circuit passing said second signal to another of said plurality of sensor modules, wherein said first signal and second signal are processed independently.

4. The apparatus of Claim 1 wherein said signal conditioning electronics have a first calibration range associated with the sensor and a second calibration range associated with said sensor, said first calibration range being wider than said second calibration value, said first calibration value being used for data acquisition and said

second calibration value being used for data display.

5. The apparatus of Claim 1 wherein one of said plurality of sensor modules is attached to a linear variable differential transformer, said step of calibrating said one of said plurality of sensor modules including the steps of:

(f) accepting scale information for the linear variable differential transformer input;

(g) setting a gain to an initial value;

(h) setting an offset to an initial value;

(i) recording a minimum voltage produced as a complete range of movement of the linear variable differential transformer is traversed;

(j) recording a maximum voltage produced as the complete range of movement of the linear variable differential transformer is traversed;

(k) identifying a linear region of operation of the linear variable differential transformer;

(l) adjusting said offset while the linear variable differential transformer is operating within the linear region; and

(m) adjusting said gain while the linear variable differential transformer is operating at a maximum desirable position within the complete range of movement.

6. An apparatus for monitoring a production process performed by a production machine, said apparatus comprising:

a plurality of module slots, each of said plurality of module slots adapted to receive a sensor module;

a processing device performing a method of monitoring a production process, said method comprising the steps of:

(a) identifying the sensor module installed in each of said plurality of module slots;

(b) calibrating the sensor module installed in each of said plurality of module slots;

(c) acquiring a stream of data from the sensor module installed in selected ones of said plurality of module slots;

(d) processing the stream of data;

(e) generating a visual presentation for the stream of data;

an interface circuit in communication between said plurality of module slots and said processing device, said interface device converting analog signals into digital signals and digital signals into analog signals;

a display device in communication with said processing device, said display device displaying said visual presentation in a human readable format;

an input device in communication with said processing device, said input device accepting commands from a user to control said processing device.

7. The apparatus of Claim 6 further comprising a switching circuit in communication with said plurality of modules slots, said switching circuit adapted to split the input from one of said plurality of sensor modules into a first signal and a second signal, said switching circuit passing said second signal to another of said plurality of sensor modules, wherein said first signal and second signal are processed independently.

8. The apparatus of Claim 6 further comprising a plurality of sensor modules installed in said module slots, each of said plurality of sensor modules accepting an input from a sensor selected from the group consisting of a linear variable differential transformer, a current loop, a dc voltage sensor, a differential voltage sensor, a piezoelectric vibration sensor, and a power sensor, each of said plurality of sensor modules including a signal conditioning circuit.

9. The apparatus of Claim 8 further comprising a gain control circuit in communication with said signal conditioning circuit of each said plurality of sensors modules and responsive to said processing device, said gain control circuit amplifying the stream of data from the sensor module installed in selected ones of said plurality of module slots.

10. The apparatus of Claim 8 wherein said signal conditioning electronics have a first calibration range associated with the sensor and a second calibration range associated with said sensor, said first calibration range being wider than said second calibration value, said first calibration value being used for data acquisition and said second calibration value being used for data display.

11. The apparatus of Claim 6 further comprising an offset control circuit in communication with said signal conditioning circuit of each said plurality of sensors modules and responsive to said processing device, said offset control circuit applying a dc voltage offset to the stream of data from the sensor module installed in selected ones of said plurality of module slots.

12. The apparatus of Claim 6 further comprising a latch control circuit in communication with said signal conditioning circuit of each said plurality of sensors modules and responsive to said processing device, said latch control circuit holding a value of the stream of data from the sensor module installed in selected ones of said plurality of module slots.

13. The apparatus of Claim 6 further comprising an input device allowing user control of said process device.

14. The apparatus of Claim 6 further comprising a machine interface in communication with the processing device and a control circuit of the production machine having control over various process parameters, wherein said processing device accepts commands from said input device and generates control signals transmitted through said machine interface thereby allowing a user to adjust the various process parameters of the production machine.

15. An apparatus for monitoring the efficiency of a production machine, said apparatus comprising:

a sensor in communication with said module circuit, said sensor module interfacing with a production machine and measuring data from the production machine;

an interface circuit in communication with said sensor;

a processing device performing a method of improving the efficiency of a production process, said method comprising the steps of:

(a) identifying said sensor;

(b) calibrating said sensor;

(c) acquiring said data about from said sensor; and

(d) generating a visual presentation from said data;

a display device in communication with said processing device, said display device presenting said visual presentation in a human readable format;

an input device in communication with said processing device, said input device accepting commands from a user thereby allowing the user to control said processing device; and

a storage device in communication with said processing device, said storage device for storing said data for later recall.

16. A method of monitoring a production process, said method comprising the steps of:

(a) identifying sensor modules installed in a hardware monitoring device;

(b) calibrating the sensor modules installed in the hardware monitoring device;

(c) acquiring data from the sensor modules;

(d) processing the data acquired from the sensor modules; and

(e) generating a visual presentation from the data acquired from the sensor modules.

17. The apparatus of Claim 16 wherein a linear variable differential transformer is being used as a sensor, said step of calibrating the sensor modules including the steps of:

(f) accepting scale information for a linear variable differential transformer input;

(g) setting a gain to an initial value;

(h) setting an offset to an initial value;

(i) recording a minimum voltage produced as a complete range of movement of the linear variable differential transformer is traversed;

(j) recording a maximum voltage produced as the complete range of movement of the linear variable differential transformer is traversed;

(k) identifying a linear region of operation of the linear variable differential transformer;

(l) adjusting said offset while the linear variable differential transformer is operating within the linear region; and

(m) adjusting said gain while the linear variable differential transformer is operating at a maximum desirable position within the complete range of movement.